Sound Practice in Planning for Improved Solid Waste Management

> What is a sound practice?
>
> **A sustainable sound practice is one which effectively accomplishes a desired result within the limitations of available financial and technical resources.**

Successful solid waste management programs require good planning. This must include an accurate assessment of existing resources and deficiencies so as to define what is required to improve or expand existing solid waste management practices.

Good planning that accurately defines solid waste management needs is particularly important in regions where economic resources are limited. In those areas, solid waste management programs must compete with all of the other necessary public services that must be funded. This requires that public officials prioritize services that are most important to the community. Effective planning also aims at assuring that necessary services are accomplished with the minimum level of assets necessary to perform the service effectively.

To achieve this, there are a number of steps that public officials can take to accurately determine the solid waste management needs for improvement or expansion of their programs. These steps include the following:

1. **A complete inventory of all existing solid waste management assets (personnel, equipment and structures) is necessary. In many cities, a needs assessment must look at both primary and secondary collection activities.**

   At the primary neighborhood or kelurahan levels, the needs assessment must look at how individual residential generators get their solid waste to communal collection points where the waste enters the secondary municipal level program. For example, kelurahans or community groups that provide door-to-door residential solid waste collection may be responsible for the management of carts and personnel who provide door to door collection service. Similarly, municipalities responsible for secondary collection and transport should complete an inventory that includes the location and physical characteristics of communal collection points, as well as the vehicles and personnel involved in the secondary collection and transport process.

2. **Each jurisdiction undertaking a needs assessment should then define the deficiencies that prevent them from providing effective service.**

   Some of these deficiencies may be quite evident by simply identifying locations where solid waste inappropriately accumulates. In other cases, some analysis is required to define the deficiency as would be the case in measuring the manner in which existing resources are applied.

3. **Once program deficiencies have been identified, the means for correcting them must be clearly defined and planning should commence to implement improvements.**

   Improvements may be accomplished by the funding and allocation of additional assets (equipment and personnel or by modifying the manner in which existing resources are applied. At a minimum, planning should include an assessment of the existing capacity of existing vehicles and staff to optimize their collection activities. Time and motion evaluations are often used for this purpose. In areas with limited financial resources, there may be a necessity to prioritize improvements so that they can be accomplished over a period of time that may be defined by available financial resources.

The following presents recommended activities and criteria that should be incorporated into a solid waste management needs assessment for local areas. Once this assessment has been completed, improvements can be planned and implemented. It is important that implemented improvements be based on sound practices that are practical and sustainable for the region in which they are to occur. An assessment of what defines a sound practice follows the needs assessment steps and criteria.

Needs Assessment Steps and Criteria

Step 1: Conduct Collection Situation Analysis

1. Gather background data
   a. Applicable laws and regulations
   b. Demographics
   c. Physical characteristics
   d. Land use
2. Conduct inventory and assess existing conditions
   a. Waste composition
   b. Generator storage and handling practices
   c. Collection service
   d. Diversion methods and programs
   e. Disposal facilities
3. Obtain input from residents and businesses
4. Waste Characterization
   a. Sources
   b. Types
   c. Quantities
   d. Seasonal variations
   e. Composition
   f. Density
5. Generator Storage and Handling Practices
   a. Container types used
   b. Accumulated waste assessment
6. Environmental, health and safety impacts
7. Impediments to best practices
8. Collection Service
   a. Management and administration
   b. Collection practices
   c. Operational performance
   d. Environmental performance
   e. Financing methods and costs
9. Diversion Methods and Programs
   a. Formal:
      i. Reuse
      ii. Recycling
   b. Informal:
   c. Reuse
   d. Recycling
10. Disposal Facilities
    a. Expected life (years)
    b. Operational impacts on collection equipment
    c. Compliance with regulations
    d. Cost
11. Obtain Input from Residents and Businesses
    a. Expectations for the type of service and its frequency.
    b. Willingness to co-operate in planning and implementation of improved service.
    c. Ability and willingness to pay for improved service

Step 2: Establish Program and Service Goals

1. Collection system planning guidelines
   a. Collection is complex and costly
   b. There is no one solution
   c. Must balance service with ability and willingness to pay
2. Typical public goals
   a. Convenient point of collection
   b. Service reliability
   c. Enforcement of applicable laws
   d. Improved public awareness and behavior
   e. Adequate and sustainable funding
   f. Monitoring of the service provider
   g. Equity of costs and benefits received

Step 3: Identify Options for Improving Collection Service

1. Point of collection
2. Materials to be collected
3. Handling of recyclable materials
4. Method of collection
5. Collection frequency
6. Service provider

Step 4: Evaluate Potentially Viable Collection System Options

1. Formulate scenarios for viable systems
2. Develop preliminary cost estimates for each scenario
3. Evaluate applicability of strategic element options
   a. Point of collection
   b. Materials to be collected
   c. Method of collection
   d. Storage container type
   e. Frequency of collection
4. Evaluation criteria
   a. Compliance with laws and ordinances
   b. Cost effectiveness
   c. Health/Safety
   d. Environmental compatibility
   e. Effectiveness
   f. Public acceptance
   g. Efficiency
5. Point of collection options
   a. At the door
   b. At the building
   c. Waste pooling sites
6. Method of collection:
   a. Manual collection
   b. Semi-automated collection
   c. Automated collection
7. Materials to be collected
   a. Bulky wastes
   b. Construction and demolition wastes (C&D)
   c. Yard wastes
8. Storage container type
   a. Plastic bags
   b. Metal or plastic rigid containers
   c. Rollout carts
   d. Large metal or plastic bins
9. Collection frequency
   a. Twice weekly
   b. Three times weekly
   c. Six times weekly
   d. Daily (seven times weekly)
10. Formulate potentially viable system scenarios
11. Develop preliminary cost estimates for each scenario

12. Use data from operational experience and assessment of existing collection system

---

Step 5: Select the Preferred Collection System

1. Solicit stakeholder input
2. Compare cost of each scenario with ability to pay
3. Make final decisions regarding strategic service elements & service provider
4. Make final strategic decisions

a. Point of collection
b. Materials to be collected
c. Storage container type
d. Method of collection
e. Frequency of collection
f. Service provider

Step 6: Implement the Selected Program

1. Develop a public awareness and communication program
2. Establish the Program Funding Mechanism
    a. Decide who will pay for waste collection service
    b. Decide how the money will be collected

In evaluating current and proposed solid waste management practices and technical options, planners must work to identify sound practices that are applicable to the specific conditions that exist in Indonesian rural and urban communities. There are a number of factors that must be considered in determining what defines sound practices.

In a general sense, a successful municipal solid waste management practice must be sustainable so that it can continue to exist beyond its initial implementation. There are many cases throughout the world where the availability of new equipment (such as waste collection vehicles) or the installation of new processing facilities (such as compost plants) did not fulfill expectations created at the time that these new systems were put into place.

In addition, insufficient institutional or financial capacity to operate and maintain a new system or equipment can lead to a situation where the new solid waste management asset cannot be operated, maintained, or managed successfully and the improvement fails. This is particularly the case in countries where donor-supplied equipment and facilities are put into place without the proper consideration or allocation of what it takes to keep the systems operable and efficient for their full technical life expectancy. System failures are common when a strong dependency is created on the donor process without establishing the ability to financially and technically support improvements or to implement equipment and facilities required to eventually replace donor systems.

Evaluating solid waste management conditions that define sound practices involves the investigation of a number of factors, including:

1. Availability of financial resources to implement new or enhanced processes
2. Level of economic development in the area of evaluation including relative cost of resources (capital, labor, etc.)
3. Level of technological development (availability of local equipment and services, etc.)

4. Level of human resource development in the municipal solid waste field (trained and competent technicians, managers, etc.) and in society in general (effective labor, etc.)
5. Physical conditions of collection areas including residences, container or TPS locations, access roads, etc.)
6. Physical conditions of disposal areas such as topography, soil characteristics, hydrogeology and the type/proximity of water bodies
7. General climate conditions that may influence system design features (temperature, rainfall, prevailing winds, etc.)
8. Specific environmental sensitivities of the region such as the extent of air pollution or the condition of water bodies near disposal areas, etc.
9. Solid waste characteristics including composition, density, moisture content, combustibility, recyclable content, and the inclusion of hazardous or biomedical waste in the municipal solid waste stream
10. Demographic and geographic characteristics such as size, population density, and infrastructure development, political jurisdictions, waste shed definitions
11. Degree to which solid waste management decisions are constrained by political considerations and the nature of those constraints
12. Existence or effectiveness of regulatory laws and enforcement
13. Policy initiatives that may exist or are under development that will influence the development of an effective solid waste management system
14. Social and cultural practices
15. Extent of informal practices such as solid waste scavenging in collection systems and disposal areas

All of the above influence the definition of sound practices for any region and they also account for the reasons why sound practices in the United States or the European Union may be different that those applicable to developing or transitional countries.

Sound Practice in Collection and Transfer

> What is a sound practice?
>
> **A sustainable sound practice is one which effectively accomplishes a desired result within the limitations of available financial and technical resources.**

When people think about solid waste management they usually visualize its collection. Collection and transfer is that part of a solid waste management system that is most visible to the public in any urban area. It also accounts for a significant portion of the cost for municipal solid waste management. In industrialized countries, collection costs range from 60 to 70% of the total cost; while developing or transitional countries spend from 70 to 90% of the total cost of solid waste management on collection and transfer.

While the percentage of total cost allocation to collection is higher in transitional countries, this does not mean that a collection system is more efficient. Typically, the service is inefficient since workers are often unmotivated, untrained and insufficiently compensated. In addition, collection is often carried out using obsolete equipment that is not well maintained. Typically, the level of service is determined by the stature of the collection area where poor areas receive a lower level of service. The high percentage of cost allocation for collection is also affected by the frequency of collection. In developing and transitional countries, collection of solid waste can occur frequently, in some cases daily.

Sound practices in many industrialized countries include the use of compactor trucks and other such vehicles specifically designed for the collection of solid waste. Non-compactor trucks are also used to collect solid waste. Some communities provide collection through a container-based system where solid waste receptacles are placed at strategic locations for receipt of waste from generators and eventual pick up by the community or a private contractor.

The type of equipment used for collection is a function of a number of factors including:

- The cost of labor and services
- The nature of collection routes (street widths, etc.)
- Historical practices
- Recycling practices

Generally, solid waste collection in many Indonesian cities is divided into two phases including:

- Primary collection which gets generated residential waste from the residences or commercials establishments to collection points and
- Secondary collection where solid waste placed at communal collection points is picked up by municipal staff or private contractors and transported to processing or disposal locations.

Primary Solid Waste Collection at the Neighborhood Level

Primary collection is the means by which solid waste is collected from individual residential generators and transported to consolidation points where it enters the secondary collection system. Consolidation points may consist of fixed communal collection structures such as TPS or containers that are strategically placed to receive waste. There are three general approaches by which primary solid waste collection can be achieved:

- Residential generators may be required to carry their solid waste to a communal collection location which may be a fixed TPS or container. If this approach is taken, sufficient collection points have to be provided to make it convenient for residential generators to dispose of their waste materials without going long distances.

- Residential generators may be served by door-to-door collection provided by either neighborhood groups or smaller units of government such as kelurahans or provided by small micro enterprise contractors who collect solid waste from individual residences for a fee. Once collected at each residence, the waste is then transported to the communal collection points that serve their neighborhoods.
- Block collection which utilizes mobile collection points where residents carry their waste at prescribed days, times and places to a passing collection vehicle which stops at a designated location to receive the waste.

Primary Collection Equipment Resources - The use of collection vehicles (manual or mechanized) is an important element that influences the design and efficiency of both the primary and secondary collection processes. Vehicles have to be selected on the basis of a number of factors including: 1) loading capacity, 2) the number of crew required to operate the vehicle, 3) costs of owning and operating the vehicle, 4) operational and maintenance requirements and 5) on the accessibility of the service area to a particular vehicle design.

Handcarts and pushcarts are often used as a low-cost means of collecting solid waste door-to-door in primary collection. Under normal service, manually operated handcarts and pushcarts are limited to about 1 kilometer with an effective speed of about 3 kilometers per hour. They are generally well-suited for the conditions normally found in low income or other areas where narrow streets, low waste generation rates, high waste density, and population density prevail. Use of handcarts and pushcarts may be warranted for primary collection in many Indonesian communities since they are typically non-polluting, inexpensive to manufacture and operate, simple in design and can usually be manufactured locally. This makes them a very important element of the sustainable low-cost technology collection approach particularly suited for primary collection.

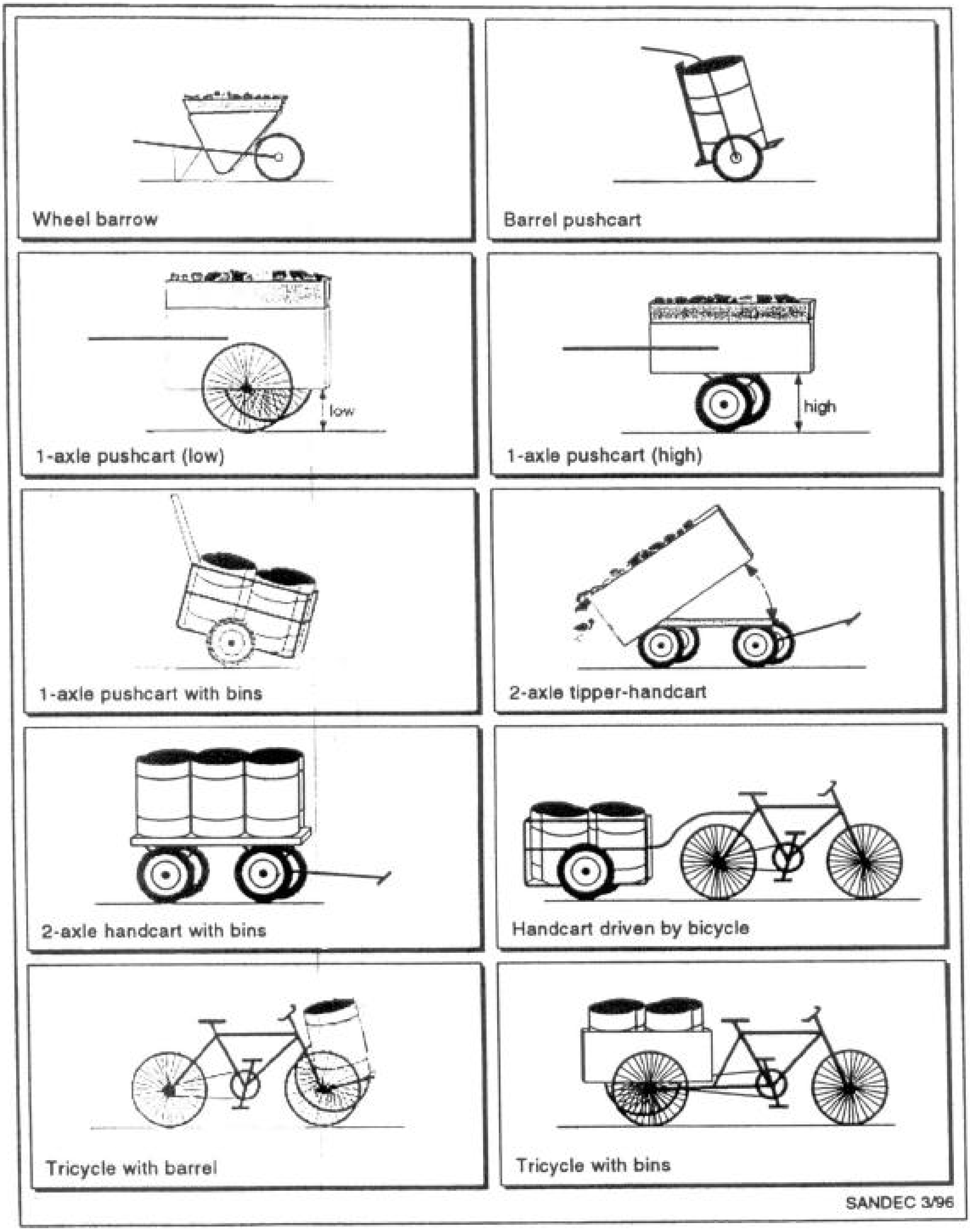
> **Primary and Secondary Collection Interface -** *One of the most important aspects of successful waste collection is the physical interface between the primary and secondary collection processes. In Manado, the existing interface configuration is one of the main problems with the current collection program. Insufficient and improperly designed or located TPS collection points make it difficult to collect solid waste in a controlled and thorough manner. The nature of the interface is determined by the way that primary collection is accomplished.*

There are a variety of different cart designs that have been used throughout the world and examples are shown in the figure on the following page. In selecting a cart design, attention should be paid to designs that allow easy handling since the carts have to be moved by manpower. This limits their loading capacity. An appropriate cart volume should range between 0.5 to 1.5 cubic meters with an upper weight limit of about 500 kg. The ultimate size of handcarts and pushcarts will also be dependent on the specific configuration and characteristics of the areas to be collected. Areas with steeply sloping roadways and difficult travel surfaces will affect cart design and capacity.

One important aspect of the proper design of a collection cart is the manner in which they are loaded and unloaded. To the degree possible, the need to dump the waste on the ground for transfer to a larger transport vehicle should be avoided. This practice is messy and significantly contributes to litter. It is also tiring work and exposes collection personnel unnecessarily to health risks in handling solid waste materials. (In areas where households use plastic bags for waste storage, this problem is less significant.) One way to overcome the need for dumping the waste on the ground is to use bins, large bags or barrels within the carts that can be lifted out for transferring material to larger vehicles.

Communal storage where household generators bring their waste to communal storage facilities such as roll-off container or concrete enclosures as is the case in Manado is the cheapest alternative in terms of direct cash requirements. In this case, households contribute in-kind services for primary collection by either providing the effort to carry their solid waste to the collection points or paying somebody else to do it. However, for this approach to be practical, communal storage points

Examples of Handcarts and Tricycles



have to be sited within a reasonable distance from generators to be acceptable to them. Generally, residential generators will willingly carry their waste between 50 and 100 meters to communal storage points. However, greater distances often leads to their seeking “more convenient” alternatives that may include illegal dumping.

In using mobile collection interfaces or block collection, residential generators will still choose to only carry their waste about 50 to 100 meters to a mobile collection point. Such locations may consist of a handcart or motorized vehicle. If the mobile collection point were a handcart, the primary collection process would still include the transportation of the collected waste in the cart to another collection point for transfer to the secondary collection system vehicle.

The most costly, but most reliable, primary collection approach is house to house collection in that it serves every household and does not rely on the willingness of generators to provide the transportation of their waste to the collection point. In many developing countries, door-to-door curbside collection with manually operated vehicles is the most widespread collection method. Household contribution in this approach is minimal in that they are only responsible to bring their solid waste to curbside or to make it available to the collector at the agreed to collection frequency.

In some cases where accessible roads are adequate, house to house collection with motorized vehicles may be more efficient than manually operated carts. However, the roadways on which the truck travels have to be able to support the traffic disruption that could occur as a result of the truck stopping frequently to collect waste. In many Indonesian communities, this would not be practical since other vehicles would not be able to move past a truck that had stopped to collect solid waste from its generators.

The main advantage of door-to-door collection with mechanized equipment is that the collected waste can be transported directly to the disposal area without any transfer to another conveyance vehicle. This effectively eliminates the interface between primary and secondary collection systems. One of the limitations of this approach is that if certain households are in inaccessible areas along the collection routes, collection personnel will have to travel considerable distances by foot to retrieve solid waste to bring it back to their vehicles if complete collection coverage is to be maintained.

The interface between the primary and secondary collection process is extremely important in determining the overall effectiveness of the collection program. If the primary collected waste is not picked up regularly at the collection or transfer sites by the secondary collection system, solid waste will accumulate to a point where containers or TPS locations may become full. Waste accumulations can lead to significant litter or odor that discourages residents and collectors from using the collection system. This is also a critical issue if mobile collection points are used since waste collectors will have to lose considerable time waiting for trucks to receive their collected waste or they may opt to dump the collected refuse elsewhere or at the site where the truck will eventually be. ***As a result, close cooperation between those providing the primary collection service and those that provide secondary collection is critical if the overall collection program is to be successful.***

In planning, recognition must be given to the fact that the primary and secondary collection processes are interdependent and, for planning purposes, do not necessarily operate as a single function. Developing an effective level of service must recognize this fact since the responsibility for each collection function may be under the jurisdiction of a different level of government.

Secondary Solid Waste Collection and Transport at the Municipal Level

Secondary collection and transfer occurs when the municipality picks up solid waste from communal collection points or containers and transports it to processing facilities or a disposal site. Secondary collection must be accomplished in an effective manner so as to keep communal collection points clean and available for service.

Communal collection points may not be serviced properly or at a sufficient frequency to keep solid waste of accumulating and spilling over. Since these are generally located in the individual neighborhoods where waste is generated, ineffectively managed collection points will add to the perception of “garbage in the streets”. If there are insufficient communal collection points, residential generators will often simply place their solid waste in “more convenient” informal locations. These uncontrolled locations are often not serviced until they become a major problem because of odor, fires, and vectors (flies, rodents, etc.)

Secondary Collection Equipment Resources - Motorized vehicles are normally required for secondary collection where greater volumes of solid waste must be managed. This is especially the case when solid waste must be transported long distances to remote disposal areas. However, in many cities throughout Indonesia, mechanized vehicles are limited to larger roadways where they are able to traverse easily. They cannot be effectively used in some narrow neighborhood roadways. While many sophisticated vehicles have been developed in industrialized countries for solid waste collection, these may not be appropriate for the collection schemes that may be required in Manado because of their cost, complexity and the characteristics of Manado’s roadways. Examples of typical mechanized equipment used in solid waste management are shown on the following page.

Additionally, there is considerable advantage in selecting a vehicle type that is manufactured locally or already in use for other general purposes within the city. Attempting to standardize the type of secondary collection mechanized vehic le helps to reduce vehicle downtime by making maintenance easier to perform since mechanics are more familiar with the equipment and spare parts may be more readily available. In some cases, agricultural tractors and trailers have proved to be a suitable choice for mechanized vehicle transfer of solid waste. This is especially the case in areas close to the disposal locations.

Personnel Resources - The number of personnel required to perform collection services is dependent on the type of vehicle used, the form of interim storage between primary and secondary collection and the operational pattern adopted in either the primary and secondary collection process. Labor-intensive systems are more likely to be used in areas where sophisticated motorized equipment cannot be considered due to high-cost or difficult operational conditions.

One of the key considerations that need to be given in developing a sustainable collection system (especially one that is labor-intensive) is the need to make sure that collectors are properly compensated. In many regions of the world, solid waste collectors have a low social status and are often paid insufficiently to even earn a living for their families. This leads to low morale and significant job turnover where any training provided to collectors is lost as a result of collection personnel leaving for better jobs. Additionally, solid waste collectors will often retrieve recyclable materials as they collect solid waste so as to supplement their earnings. This practice can influence the efficiency of collection by reducing the time that a collection crew actually spends collecting solid waste.

Collection Frequency - ***One of the key decisions that must be made in defining solid waste collection services is the frequency at which the solid waste is collected at both the primary and secondary level.*** In some instances, decreasing the frequency of collection can provide sufficient savings to allow enhancement or expansion of the collection services. However, this is only practical in areas where solid waste storage does not create aesthetic problems such as odors. ***In Indonesia, prevailing temperatures will, more than likely, require frequent collection.*** As a result, the collection system has to provide the means by which residential solid waste is removed from residences daily. Organic solid waste will start to decompose within one or two days. Beyond that time offensive odors may result. The primary collection system has to provide the means by which solid waste is removed from the residences daily while the secondary system must manage the material at the TPS or containers frequently enough so that odor and vector (flies, etc.) problems do not develop at the collection points. When this latter situation occurs, nearby residents sometime start fires to eliminate resulting odor and vectors. However, this often results in the replacement of an aesthetic problem with a potentially greater health impact due to the migration of smoke from the burning solid waste to nearby residences and businesses.

In some circumstances, consideration should be given to the construction of transfer depots that would allow for greater consolidation of solid waste material prior to transport to disposal locations. Since transfer depots may serve more than one residential area or jurisdiction depending on its location, they should best be developed by the municipality as an enhancement of its container-based collection services. In the coordination of a thorough needs assessments, potential locations for transfer depots may become evident.

Sound Practice in Solid Waste Reduction and Recycling

What is a sound practice?

A sustainable sound practice is one which effectively accomplishes a desired result within the limitations of available financial and technical resources.

Solid waste source reduction and recycling are a means of diverting a portion of the solid waste stream from disposal facilities to recovery and reuse. Some solid waste components have value if they can be effectively separated from the overall solid waste stream without too much contamination. Common recyclables include ferrous and nonferrous metals, construction debris, scrap tires, paper/cardboard, plastics, textiles, glass, wood/timber, animal bones and feathers, waste oil and grease, and cinders.

In some urban centers such as those in Australia, Japan and Korea where economic resources exist to support formal recycling programs, a high degree of waste reduction, source separation, and recycling occurs. These programs have evolved through extensive public education and practices such as curbside collection. In Singapore, for example, about 38% of the total generated municipal solid waste is recycled by commercial companies. The recycled materials come from industry and commercial establishments as well as the extraction of commercially viable waste components such as papers, cardboard, textiles, plastics, and glass collected from households. The level of economic resources available in these locations defines the above as sound practice for those areas. However, for areas with more limited resources these targets may not be realistic.

There are many examples throughout the region of government support for waste reduction and recycling programs. For example, in China and Vietnam waste recovery and recycling has been organized at the city level and programs have been supported by national ministries. Major cities have public and private companies that collect recyclables from offices, institutions, and factories. They also have neighborhood redemption centers where people can sell materials such as bottles, paper, and clothes.

In many developing countries, informal source separation and recycling have always been practiced by an informal sector (comprised of waste pickers, buyers, traders, and recyclers). This practice has been based on inherent frugal habits, resource scarcity, and high levels of poverty. These traits have also fostered a strong reliance on repair industries that reduce the amount of waste generated.

Informal recycling occurs at three points in a typical solid waste management system:

1) Initial recycling begins with scavengers removing materials from containers or waste accumulations before collection.

2) The second level occurs within the collection process itself when collection personnel remove materials as they are collecting the waste.

3) The third level of recycling occurs at disposal areas where materials are removed by scavengers from waste that is dumped.

Materials that have historically been separated or picked out from mixed wastes include ferrous and nonferrous metals, papers/cardboard, glass, plastics, clothing, leathers, animal bones/feathers, books and household goods which are repaired and sold in second-hand markets. Some typical examples of the informal recycling industries are those which recycle broken glass into bottles, waste plastics to toys and shoes, and waste paper to paper board. The activities are mainly driven by the scarcity and expense of raw materials. Scavengers will recover any materials that may then be sold to small and large dealers and wholesalers who may in turn sell the material to manufacturing facilities or larger consolidators. Many large industries deal entirely with recyclables such as papers, ferrous metals, plastics, and glass.

The economic stimulus for this activity is the fact that scavengers will often earn their livelihood by recovering and selling these materials. (***Effective planning of solid waste management improvements***

in any jurisdiction need to consider the effect of scavengers within their programs. Occasionally, cities in developing countries have attempted to ban scavengers from dump sites to discourage dependence on this activity as a livelihood. However, such regulations have proved near impossible to enforce. Since many of the people involved in scavenging rely on the process for their livelihood, the social implications of eliminating practice must also be considered in solid waste management planning.)

Based on observations in many developing countries, informal recycling occurs at three points in a typical solid waste management system. Initial recycling begins with scavengers removing materials from containers or waste accumulations before collection. The second level occurs within the collection process itself when collection personnel remove materials as they are collecting the waste. Recovered materials are normally placed in sacks, boxes or whatever may be convenient on a collection truck. Unfortunately, this form of recycling can significantly impact collection efficiency by slowing down the collection process. The third level of recycling occurs at disposal areas where materials are removed by scavengers from waste that is dumped. People who scavenge at disposal areas generally work in very poor conditions at considerable health and safety risk. Many of the people who do this live at or near the disposal site. NGOs in some countries have assisted waste scavengers in forming cooperatives to collectively obtain source-separated wastes. Some of the ways scavengers can be brought into a formal recycling program include the following:

- Subsidize personal protective equipment and clothing to reduce the health risks of scavenging
- Provide access to basic health care in inoculations against illnesses such as tetanus
- Regulate scavenging and waste picking by providing designated areas at which the activities allowed
- Assist scavengers and waste pickers to organize cooperatives so as to increase their earnings and working conditions
- Help to control harassment and image issues associated with street pickers in scavengers

In larger landfills, scavengers are a major problem and often impede proper operation of the disposal site. The materials recovered from disposal areas are usually of a lower quality than those removed earlier in the solid waste management system since they are usually dirtier and more contaminated because of their contact with other materials placed into the disposal area. ***As a result it is generally desirable to shift recycling toward the generation and collection end of the system and away from the disposal end. This forms the basis for many of the successful recycling programs that have been developed throughout the world.***

Any recycling activity, formal or informal, is driven by the availability of markets for the recover materials. Generally, industries are interested in using recycled materials only when the cost of doing so is less than the cost of using virgin materials in their manufacturing processes. In other words, available markets provide the economic incentive for the activities undertaken by formal and informal recyclers. However, successful recycling is not guaranteed simply by available markets. Solid waste program managers must also give attention to making recycling programs economically efficient and maximizing public participation.

The following is a general sequence of activities that should be followed in the implementation of a successful recycling program.

1. Identify the goals for the recycling program
2. Characterize recyclable material volume and accessibility within the waste stream
3. Assess and generate political and public support
4. Assess markets and market development strategies for recyclables
5. Assess and choose technologies and practices for collection and processing

6. Consider the effect of the proposed program on informal recyclers (also consider the effect of the informal recyclers on the proposed program)
7. Develop a budget and an organizational plan
8. Implement education and publicity program
9. Commence program operation
10. Supervise the ongoing program and continue publicity/education
11. Review and adjust program as necessary based on the experienced gained during its implmentation.

The long-term success of any formal recycling program depends strongly on public participation. Citizens and local officials must be constantly reminded of the environmental, economic, and social reasons for reducing landfill waste. Program publicity, promotion, and education must be ongoing to accomplish this.

Sound Practice – Composting

What is a sound practice?

A sustainable sound practice is one which effectively accomplishes a desired result within the limitations of available financial and technical resources.

Composting involves the aerobic biological decomposition of organic materials to produce a stable humus-like product. Backyard composting is considered to be a form of source reduction or waste prevention because the materials placed into a backyard compost system are completely diverted from the municipal solid waste management system. Community level composting programs that process source-separated organics or mixed MSW are considered forms of recycling since the material has usually entered the formal solid waste management program before diversion to the composting process.

In this discussion two approaches to composting are highlighted: those at the household level and larger facilities that are managed by municipalities. The latter is often run by machine and considerable more complex than one managed at the household level. As has been demonstrated in this Project's pilot studies, household composting is a practical, affordable and low maintenance way for a community's citizens to reduce solid waste.

While a significant percentage of the residential waste stream is organic material, the other components can significantly affect the viability of producing compost from a mixed waste stream. Composting organic materials, especially organic waste diverted from markets, can significantly reduce waste stream volume from these facilities. The quality of produced compost depends on a number of factors including:

1. Particle size,
2. pH,
3. The presence of soluble salts,
4. Stability, and
5. The presence of undesirable components such as weed seeds, heavy metals and undesirable materials such as plastic and glass.

In many industrialized countries where solid waste management costs are high, composting offers significant economic advantages. However, this economic driver is often not a major factor in many developing countries where disposal costs are low because of substandard disposal practices. The challenges to developing effective compost programs include the following:

1. Developing markets and stable end uses of the produced compost
2. A lack of standards for finished compost
3. Lack of experienced designers, vendors, and technical staff available to many municipalities
4. Potential problems with odors in poorly managed processes
5. Potential problems controlling contaminants that affect the agricultural value of the compost
6. Inadequate understanding of the biology and economics of composting

As long as the informal and formal processes for eliminating non-organic fractions from the waste stream can be brought into control, a sound practice for local governments in developing countries is to emphasize the diversion of organic material from the waste stream to small to moderate scale composting systems. The high percentage of the organic fraction provides the greatest opportunity for diversion from disposal facilities.

Several factors determine the chemical environment for composting including:

1. The presence of an adequate carbon (food)/energy source,
2. A balanced amount of sufficient nutrients,
3. The correct amount of water,
4. Adequate oxygen,
5. Appropriate ph, and
6. The absence of toxic constituents that could inhibit microbial activity.

The ratio must be established on the basis of available carbon rather than total carbon. An initial ratio of 30:1 carbon/nitrogen is considered ideal. To lower the carbon/nitrogen ratios, nitrogen-rich materials (yard trimmings, animal manures, biosolids, etc.) are added.

Because the water content of most solid waste materials introduced to the compost process is not adequate, water is usually added to achieve the desired rate of composting. A moisture content of 50 to 60 percent of total weight is ideal. Excessive moisture can create anaerobic conditions, which may lead to obnoxious odors. Adding moisture may be necessary to keep the composting process performing at its peak. Evaporation from compost piles can also be minimized by controlling the size of piles. pH affects the amount of nutrients available to the microorganisms, the solubility of heavy metals, and the overall metabolic activity of the microorganisms. A pH between 6 and 8 is normal.

The four composting technologies are windrow, aerated static pile, in-vessel, and anaerobic composting. Supporting technologies include sorting, screening, and curing. The technologies vary in the method of air supply, temperature control, mixing/ turning of the material, and the time required for composting. Their capital and operating costs also vary considerably.

One or two screening steps and possibly additional grinding are used to prepare the compost for markets. For screening to successfully remove foreign matter and recover as much of the compost as possible, the compost's moisture content should be below 50 percent.

Effective composting requires control of the process. Some of the technical aspects that must be considered in composting include the following:

- **Backyard composting -** Backyard composting is a good way to manage household kitchen garden waste. While this is the smallest scale of composting and the material be composted comes only from one source it is a sound approach when:
  - A significant number of households have sufficient room for compost pile—it is also practical for an individual household to have its own compost
  - There is a need for compost at the individual residences
  - The compost activity is culturally familiar to the population in general
  - The waste stream to be composted contains primarily vegetable matter which can help to control rodents and insects
- **Coordinated backyard compost systems -** Backyard composting generally consists of household-level aerobic decomposition of household organic garden and kitchen wastes. The resulting compost is usually used at the residence itself for organic fertilizer. Sound practice in organized backyard composting systems includes the following:
  - Government purchase or subsidy of backyard composters
  - An intensive program of public education
- The implementation of small scale backyard composters as pilot project to demonstrate the technology and its application.
- **Volume reduction -** All composting processes result in volume reduction because of the action of bacteria that transforms waste material components into humus, steam and gases. In addition,

insects and microorganisms feed on organic material. Additional volume reduction occurs through removal of non-compostable materials during pre-processing or final screening. Because of the above actions, 100 tons of compostable waste material can produce about 30 to 50 tons of compost depending on the physical characteristics of the feed material.

- **Duration of the composting process** - Composting is completed when the compostable materials have been completely converted to humus. Final compost can be tested by re-wetting the material and observing if it heats up again. If it does heat up, this indicates that there are still uncomposted materials in the pile that begins to stimulate biological action. Most aerobic composting processes require a period of active composting (generally from 21 to 60 days) and a period of curing (generally from 6 to 24 months). The composting process can be accelerated by intensive aeration through forced air systems and through inoculation of the piles with suitable bacteria to stimulate biological action.
- **Marketing of compost** - Effective marketing of compost is important to sound practice. In industrialized countries, compost is ordinarily considered to be a soil amendment, rather than a fertilizer because of its relatively low nutrient value. It is considered to have value as a soil conditioner for dense or sandy soils, assisting all soils to retain moisture, synthetic fertilizers, and natural nutrients. It is useful in regulating soil temperature and in preventing erosion. Compost has also been known to inhibit destructive agricultural diseases and pests.
- **Small-scale composting of animal wastes** - Composting and digestion of bones is often implemented as a small industry in some developing countries. This process can produce ingredients for the manufacture of fertilizer, animal feed, and glues. Small-scale aerobic composting of animal wastes such as manures, hide scrapings, and tannery and slaughterhouse wastes can also produce fertilizers but care is required because of potential pathogens.
- **Pre-processing** - Pre-processing is a technical component of almost all composting systems above the level of backyard composting. Pre-processing is usually necessary to create the conditions for bacterial action and usually consists of three separate types of operations:
    - Separation or removal of oversize, non-compostable, or dangerous materials;
    - Size reduction to create many small particles suitable to sustaining bacterial action by increasing the surface area available for biological action; and
    - Blending of materials to adjust the carbon-nitrogen ratio, moisture content, or structure of the materials to be composted so as to optimize the composting process.

  Mechanical pre-processing is usually the most costly part of a community level composting system. It is also the most likely to breakdown. Because of this, sound practice in composting involves minimizing pre-processing to the extent possible by pre-selecting the waste streams to be composted through source separation and separate collection.
- **Windrow and active pile systems** - A sound and simple form of composting involves the construction and maintenance of piles of compostable material. The piles, called windrows, form the basic environment for compost bacteria and other organisms to accomplish decomposition and biological conversion. Important considerations in using windrows for composting include:
    - The size of the windrows, which must be of sufficient mass to allow for heat build-up. The composition of the wastes and the climate in the area where composting occurs are the two primary factors in determining windrow size.
    - The shape of the windrows, which is related to the type of aeration that is used and the type of equipment used to aerate;
    - Whether the windrows are open or covered (This usually depends on the climate and the moisture content of the waste); and
    - The spacing of the windrows, which is dependent on the size of the site and type of equipment used to turn and process the material.

Active pile systems require manual or mechanical turning of the windrows, with crews using shovels or rakes, or with equipment such as a bulldozer, tractor, or windrow turning machine. Turning aerates the piles, blends the materials, brings about additional size reduction, and prevents excessive buildup of temperature to the point of spontaneous combustion. An active pile system:

- Has relatively high land use requirements;
- Uses a varied amount of labor, depending on whether compost turning is manual or mechanical;
- Has low capital cost and low-to-moderate operating cost;
- Can be developed without purchase of specialized equipment. Mechanical turning can be done with loaders or bulldozers, which are common equipment in solid waste management functions.
- May use a variety of compostable materials; and
- May release odors during turning early in the composting cycle. A large buffer zone between the composting site and neighboring residences may be needed, especially if the windrows are infrequently turned.

- **Windrow turning machines.** Specially designed windrow turning machines have been developed in the US, Asia, and Europe. These vary in size from a tractor attachment to the large specially designed turner, which straddles the windrows. Windrow turning machines allow for production of a more uniform compost. They decrease labor costs but increase the capital costs of active pile systems. Compared to bulldozers, however, specialized windrow turning machines are more effective in aerating windrows and may therefore be a cost-effective alternative.
- **Static pile systems -** In static pile composting systems, the windrows are not turned but are aerated continuously or periodically using forced air systems. Static piles typically require a site with aeration channels built into the pad on which the piles sit. Piles are built over this channel, and a network of perforated piping is introduced during placement into piles of the materials to be composted. During composting, air is blown or drawn by pipe systems driven by electric or gas motors through the static piles to provide aeration.
- **In-vessel systems -** In an in-vessel system, much of the composting process is carried out indoors or inside a vessel with a large, enclosed chamber in which mechanical mixing and/or forced aeration are performed where moisture, air, and temperature can be controlled to create the optimal conditions for composting.

  In-vessel systems offer protection from weather conditions, better odor control, and shorter periods of active processing, but they are expensive to build and operate. Their status as a sound practice for developing countries is open to question, especially since equipment and parts typically have to be imported and paid for with foreign exchange.

There are many successful small and medium-sized composting installations that are functioning successfully in countries such as China and India using the above technical configuration and processes. Unfortunately, there are also examples of many attempts at establishing community level composting in developing or transitional countries that have failed. This is particularly the case where large mixed waste compost plants have been constructed. Common reasons for such failures have included:

1. **Economic Failure** - In some cases, there has been an inability to secure sufficient waste to process as a result of the competing costs of disposal alternatives. Compost plants have also failed as a result of an inability to market end-product compost. This is often a function of agricultural practices in the region where the compost is produced. These practices will determine the external demand to use the material as a soil conditioner. Experience across the world has shown that compost marketing works best when:

- Available markets are near the source of production
- Compost producers are willing to transport it to the consumers
- Compost is priced below other commercially available soil conditioners or given away to the consumers.

2. **Technical Failure** – Composting failures around the world have been due to technical issues such as:
   - Failure of mechanical pre-processing systems used to condition the solid waste for composing,
   - Failure of the biological process as a result of not controlling the technical parameters (moisture content, carbon/nitrogen ratio, etc.) required for effective compost production
   - Insufficient organic content in the mixed waste stream to support the process.

The compost systems that have generally been effective across the world are those that focus on the use of source-separated materials high in organic content. Examples of such materials include animal and vegetable waste such as that derived from market applications.

The marketability of compost can be controlled by selectively accepting feedstock materials. Feedstock material should be carefully controlled to ensure consistent compost quality. The definition of source-separated organics can include specific waste from markets, food scraps, yard trimmings, and sometimes paper. The advantage of source-separated organics composting is the ability to produce relatively contaminant-free compost. A contaminant-free feedstock is important for producing high-quality compost.

The steps that may be taken in developing an effective compost program include the following:

1. Identify goals of the composting project
2. Identify the scope of the project—backyard, yard trimmings, source-separated, mixed MSW, or a combination
3. Get political support for changing the community's waste management approach
4. Identify potential sites and environmental factors
5. Identify potential compost uses and markets
6. Initiate public information programs
7. Inventory materials available for composting
8. Visit successful compost programs
9. Evaluate alternative composting and associated collection techniques
10. Finalize arrangements for compost use
11. Obtain necessary governmental approvals
12. Prepare final budget and arrange financing
13. Construct composting facilities and purchase collection equipment, if needed
14. Initiate composting operation and monitor results